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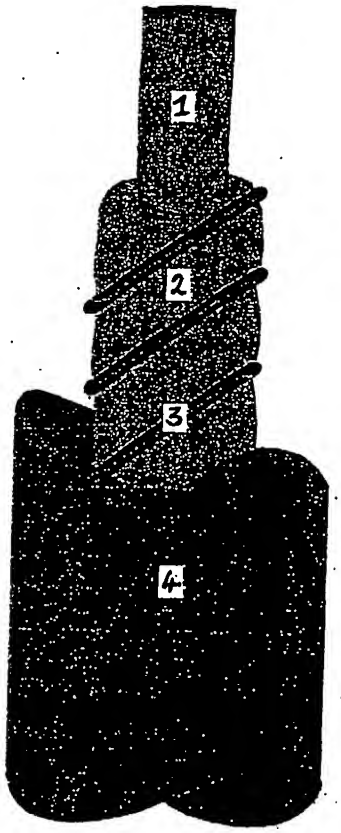
(54) Abstract Title
An electric heating cable having a meltdown layer applied to a linear conductive core and a heating element spirally wound along the meltdown layer

(57) An electrical heating cable having a linearly extending conductive core 1 along a central part of the cable, a meltdown layer 2 applied to the conductive core 1, and a heating element 3 wound spirally along the meltdown layer 2, so that it is electrically separated from the conductive core 1. The cable may be used in an electric blanket with overheating protection.



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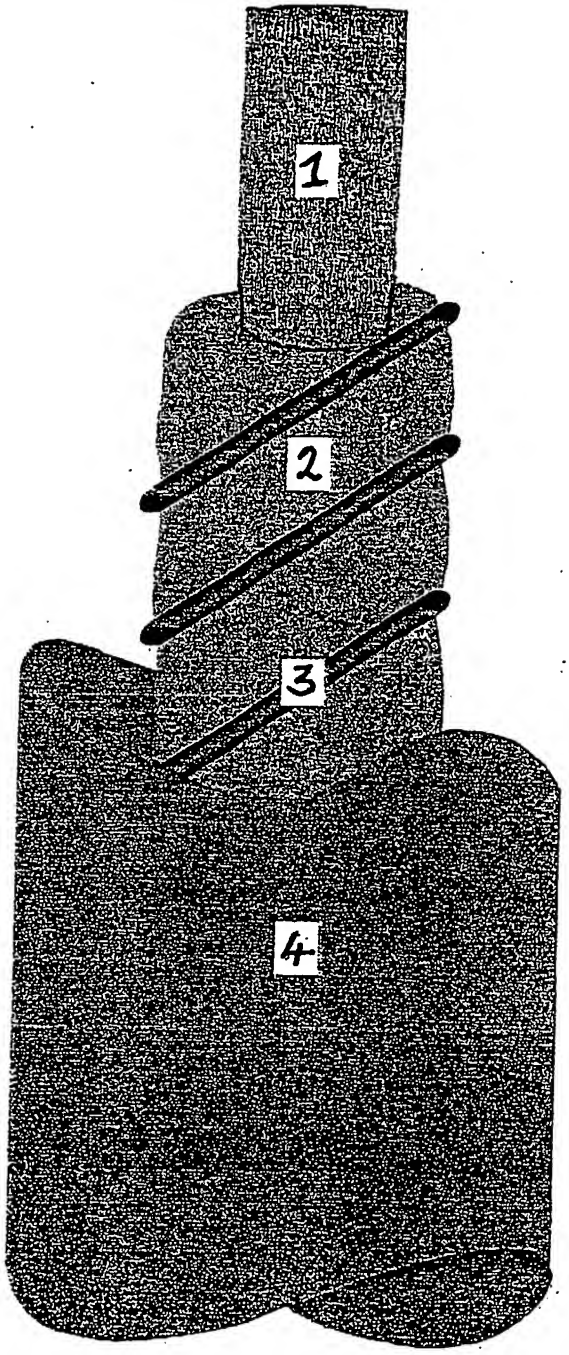
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An Electrical Heating Cable

This invention relates to an electrical heating cable.

Many applications today find a use for electrical heating cables. Examples are electrically heated bedding such as electric blankets, electrically heated clothing, underfloor heating, and even outdoor applications for warming soil and/or frost protection.

An example of an electrical heating cable in an electric blanket is disclosed in WO 99/30535, wherein an inner fibre core is wound with a spiral heating wire, on top of which is applied a meltdown layer and then, on top of that, a spirally wound sensor wire. The whole cable is then covered by a PVC outer layer. Traditionally, when an electric blanket overheats severely, localised destruction of the meltdown layer causes the two spirally-wound wires to contact one another, and the electric blanket to be controlled to switch off.

The provision of two spirally-wound wires can be expensive, and can lead to a construction which can be bulky, requiring the cable as a whole to have a relatively large diameter, which is disadvantageous in some situations, e.g. in electric blankets.

According to the present invention there is provided an electrical heating cable comprising an electrically conductive core providing a non-spirally extending electrical path along a central part of the cable, a meltdown layer applied on the electrically conductive core, and a heating element wound spirally along the meltdown layer so as to be normally

electrically separated from the electrically conductive core by the meltdown layer.

An embodiment of the invention can provide a heating cable with an advantageously small diameter. Thus the electrically conductive core needs only to be sufficiently thick as to conduct a relatively low electrical signalling current, while the heating wire provided nearer to the outer surface of the cable enables an efficient transfer of heat thereto.

In addition to providing the basic safety feature of meltdown against severe overheating, it is possible to provide embodiments of the invention wherein a more sensitive detection of rise in temperature can be made, enabling the supply of heating current to the heating element to be cut-off before meltdown occurs, or even enabling the supply of heating current to be controlled to provide a desired temperature.

This feature could be achieved by the meltdown layer being such as to change an electrical property thereof in dependence upon rise in temperature, enabling detection of a heating effect when the cable is in use.

To this end, the meltdown layer could have PTC properties.

Alternatively or in addition, the electrically conductive core could be such as to change an electrical property thereof in dependence upon rise in temperature, enabling detection of a heating effect when the cable is in use, and this could be achieved by the electrically conductive core having PTC or NTC properties.

For a better understanding of the invention and to show how it may be put into effect reference will now be made, by way of example, to the accompanying drawing wherein the single figure shows a preferred embodiment of heating cable according to the present invention.

The single figure shows, in greatly enlarged form, a heating cable that provides a spirally-extending electrical path for heating current and, further, incorporates a non-spirally extending electrically conductive path for providing signalling and/or heat sensing and detection. Various modifications will be described, enabling the latter electrically conductive path to be provided in various ways.

In order to provide the signalling path, a linearly-extending electrically conductive inner core 1 is made from textile core material, preferably constructed from carbon fibres and/or carbon/graphite fibres in the form of a yarn, tow, or strands of threads, possibly with a metallic coating or impregnation.

In an alternative arrangement, the inner core 1 could be constructed from ceramic fibres in the form of a yarn, tow, or strands of threads, again possibly with a metallic coating or impregnation. Further, the inner core 1 could be constructed from one or more strands of drawn or extruded metal or metal alloy.

As already mentioned, the inner core 1 can act as a signal conduit and/or a heat sensing or detecting conductor, which could serve to provide a current/signal path to an electrical/electronics controller when the cable is in use, possibly as a heating cable in an electric blanket.

This current/signal path could be utilized as:-

a) an overheat protection conduit by detecting current leakage between itself and an outer heating wire 3 (yet to be described);

b) a heat sensing/detection circuit to control a power supply to the outer heating wire 3 when the cable is in use;

c) a combination of a and b.

The inner core 1 of the heating cable is coated with a heat sensing separation layer 2 of e.g. plastics, thermoplastic elastomer or rubber. Around the layer 2 is wrapped a spirally, i.e. helically, wound metal heating wire 3 that serves as the heating element. The cable as a whole is then electrically insulated with an outer coating layer 4 of e.g. plastics, thermoplastic elastomer or rubber to provide outer dielectric strength insulation properties for the cable.

The principle of operation of the just-described embodiment is that the normally electrically-insulating heat sensing separation layer 2 has heat meltdown characteristics. Also, it will soften at a temperature rating of between 101-164 degrees centigrade, which is a temperature indicating overheating of the cable and/or the device (e.g. electric blanket) in which it is installed when in use. This softening will create an electrical path across the separation layer 2, enabling current leakage to take place between the outer heating wire 3 and the inner core 1, thereby allowing a signal to be sent via the inner core 1 to an electrical/electronic controller, electrically

connected to the inner core 1, that will activate an overheat protection system of the electrical/electronic controller of e.g. the electric blanket. The activated overheat protection system could then stop the power supply to the outer heating wire 3, to prevent the overheated state continuing.

It has been found that employing an inner core as a signalling path enables the cable to be constructed with a small diameter. Thus the signalling path need not carry a large current, and it can have a simple linear configuration without being spiral. Having a small diameter is an important factor in applications such as electric blankets for maximum comfort of the user, particularly in the case of an underblanket upon which the user lies. Small diameter heating cables are advantageous in other applications also.

There are several constructional variations which may be incorporated in a heating cable of the present invention, as follows:

It would also be possible to provide the heat sensing separation layer 2 with positive temperature coefficient (PTC) properties so that its resistance increases with temperature increase. This change in resistance can be detected via the inner core 1, and used by an electrical/electronic controller as a means of controlling the power to the helically wound metal heating wire 3. In this way not only can overheating be detected and stopped, but also the temperature can be controlled to be higher or lower depending on the requirements of the user.

Additionally or alternatively, the inner core 1 could have positive temperature coefficient (PTC)

properties so that its resistance increases with temperature increase. Again this change in resistance can be detected and used by an electrical/electronic controller as a means of controlling the power to the helically wound metal heating wire 3, possibly creating a second PTC heat sensing/detection capability for the embodiment.

Alternatively, the inner core 1 could have negative temperature coefficient (NTC) properties so that when its resistance decreases with temperature increase, this change in resistance can be detected and used by an electrical/electronic controller as a means of controlling the power to the helically wound metal heating wire 3.

It is to be appreciated that in a simple embodiment, no temperature-indicating means need be provided. The meltdown characteristics of the separation layer 2 are sufficient. Alternatively, just one temperature-indicating means can be provided, by a property of either the inner core or of the meltdown layer.

In a more sophisticated embodiment however, the inner core and the meltdown layer can provide separate temperature-indicating means. In this way one temperature-indicating means can provide back-up against failure of the other temperature-indicating means, or the two could serve separate functions. Thus one could be employed for start-up or fast control when a heating current is switched-on, with the other then taking-over for steady-state temperature control. The final back-up safety feature relies on the meltdown characteristics of the separation layer 2.

It is to be noted that the skilled man will be aware of materials which have, or which can be adapted in a known manner to have, NTC or PTC properties for use in the separation layer 2 and/or in the inner core 1, whereby it is the electrical resistance thereof which changes to detect the heating effect of the heating wire 3.

In some embodiments it would be possible to make the inner core 1 from non-electrically conductive textile core material such as polyester tow or yarn, to which is applied a metallic coating or impregnation.

In the described and illustrated embodiment of the present invention, the inner core 1 acts as a sensing and/or detection conductor which serves to provide a current and/or signal path to an electrical/electronics controller when the cable is in use. The inner core 1 is not used as a means of heating, but merely for receiving and/or applying a signal. The inner core 1 may thereby be used as an overheat protection conduit. It may detect current leakage between itself and the outer heating wire 3, and thereby can be used to control power supply to the outer heating wire 3.

CLAIMS:

1. An electrical heating cable comprising an electrically conductive core providing a non-spirally extending electrical path along a central part of the cable, a meltdown layer applied on the electrically conductive core, and a heating element wound spirally along the meltdown layer so as to be normally electrically separated from the electrically conductive core by the meltdown layer.

2. A cable according to claim 1, wherein the meltdown layer is such as to change an electrical property thereof in dependence upon rise in temperature, enabling detection of a heating effect when the cable is in use.

3. A cable according to claim 2, wherein the meltdown layer has PTC properties.

4. A cable according to claim 1, 2 or 3, wherein the meltdown layer is made of plastics, thermoplastic elastomer or rubber.

5. A cable according to any preceding claim, wherein the electrically conductive core is such as to change an electrical property thereof in dependence upon rise in temperature, enabling detection of a heating effect when the cable is in use.

6. A cable according to claim 5, wherein the electrically conductive core has PTC properties.

7. A cable according to claim 5, wherein the electrically conductive core has NTC properties.

8. A cable according to any preceding claim, wherein the electrically conductive core comprises fibres assembled in the form of a yarn, a tow, or strands of threads.

9. A cable according to claim 8, wherein said fibres comprise textile fibres.

10. A cable according to claim 8 or 9, wherein said fibres comprise carbon fibres and/or graphite fibres.

11. A cable according to claim 8, 9 or 10, wherein said fibres comprise ceramic fibres.

12. A cable according to claim 9, wherein said fibres comprise polyester fibres.

13. A cable according to any of claims 8 to 12, wherein said fibres have a metallic coating or impregnation.

14. A cable according to any of claims 1 to 7, wherein the electrically conductive core comprises one or more strands of drawn or extruded metal or metal alloy.

15. A cable according to any preceding claim, and further comprising an outer layer of electrically insulating material.

16. A cable substantially according to any one of the embodiments hereinbefore described with reference to the accompanying drawing.

17. A heating device comprising a heating cable

according to any preceding claim.

18. A heating device according to claim 17, which is an electric blanket.

INVESTOR IN PEOPLE

Application No: GB 0201888.5
Claims searched: 1-18

Examiner: Richard Kerslake
Date of search: 26 March 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H2K (SB1,SB9); G3R (RBQ52)

Int Cl (Ed.7): H05B 3/56; H02H 5/04

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	JP 020098088 A	(MATSUSHITA) Abstract & Figs 3 & 4	1,8,13,15 at least
X	US 6002117 A	(PAK) Fig 3 & Col 1 line 51 - Col 3 line 2	1 & 15

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.